

$\eta_b(1S)$

$$J^{PC} = 0^+(0^-+)$$

OMITTED FROM SUMMARY TABLE

Quantum numbers shown are quark-model predictions. Observed in radiative decay of the $\Upsilon(3S)$, therefore $C = +$.

NODE=M171

NODE=M171

$\eta_b(1S)$ MASS

NODE=M171M

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT
9398.0 ± 3.2 OUR AVERAGE Error includes scale factor of 1.8. See the ideogram below.
 [9391.0 ± 2.8 MeV OUR 2012 AVERAGE]

NODE=M171M

NEW

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
9402.4 ± 1.5 ± 1.8	34k	¹ MIZUK	12 BELL	$e^+e^- \rightarrow \gamma\pi^+\pi^-$ + hadrons
9391.8 ± 6.6 ± 2.0	2.3 ± 0.5k	² BONVICINI	10 CLEO	$\Upsilon(3S) \rightarrow \gamma X$
9394.2 ⁺ _{-4.8} ± 2.0	13 ± 5k	² AUBERT	09AQ BABR	$\Upsilon(2S) \rightarrow \gamma X$
9388.9 ⁺ _{-2.3} ± 2.7	19 ± 3k	² AUBERT	08V BABR	$\Upsilon(3S) \rightarrow \gamma X$

• • • We do not use the following data for averages, fits, limits, etc. • • •

9393.2 ± 3.4 ± 2.3	10 ⁺ ₋₄	^{2,3} DOBBS	12	$\Upsilon(2S) \rightarrow \gamma$ hadrons
9300 ± 20 ± 20		HEISTER	02D ALEP	181-209 e^+e^-

¹ With floating width. Not independent of the corresponding mass difference measurement.

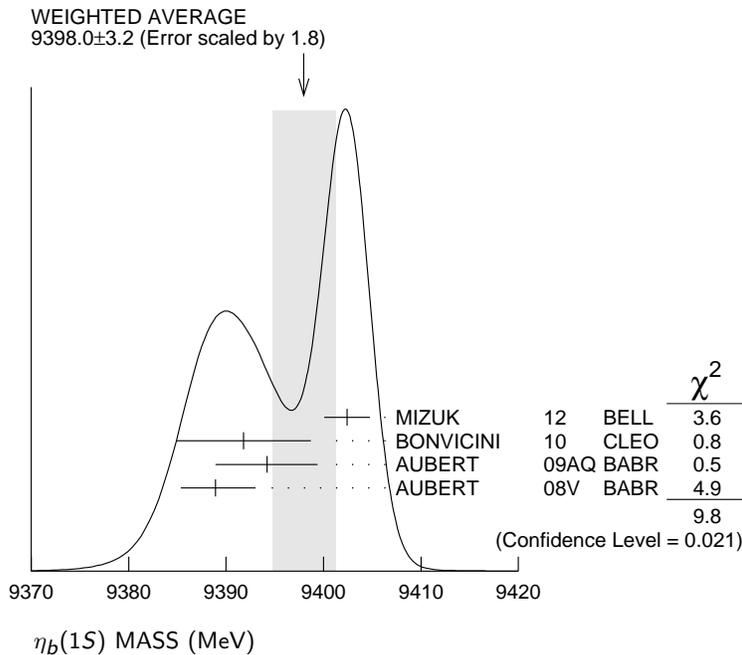
² Assuming $\Gamma_{\eta_b(1S)} = 10$ MeV. Not independent of the corresponding γ energy or mass difference measurements.

³ Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

NODE=M171M;LINKAGE=MI

NODE=M171M;LINKAGE=AU

NODE=M171M;LINKAGE=DO



$m_{\Upsilon(1S)} - m_{\eta_b}$

NODE=M171M2

VALUE (MeV) EVTS DOCUMENT ID TECN COMMENT
62.3 ± 3.2 OUR AVERAGE Error includes scale factor of 1.8. See the ideogram below.
 [69.3 ± 2.8 MeV OUR 2012 AVERAGE]

NODE=M171M2

NEW

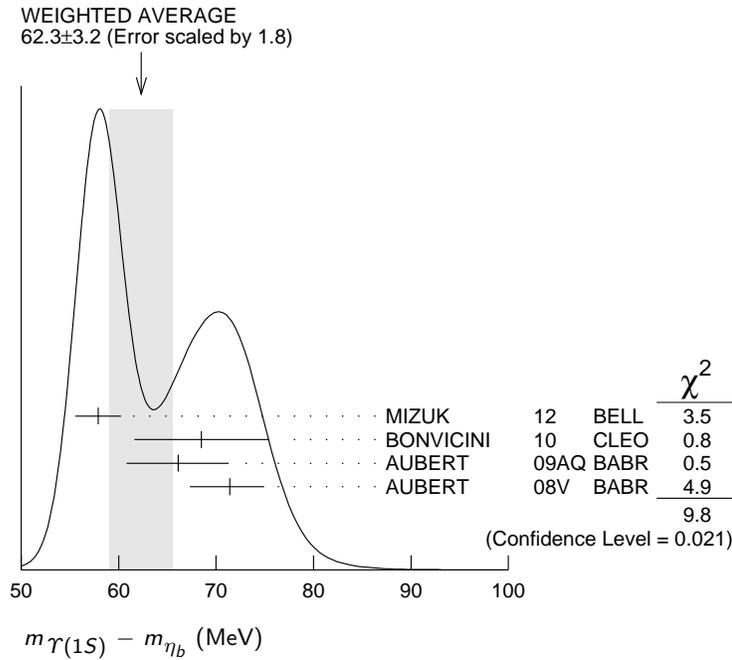
VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
57.9 ± 1.5 ± 1.8	34k	⁴ MIZUK	12 BELL	$e^+e^- \rightarrow \gamma\pi^+\pi^-$ + hadrons
68.5 ± 6.6 ± 2.0	2.3 ± 0.5k	⁵ BONVICINI	10 CLEO	$\Upsilon(3S) \rightarrow \gamma X$
66.1 ⁺ _{-4.8} ± 2.0	13 ± 5k	⁵ AUBERT	09AQ BABR	$\Upsilon(2S) \rightarrow \gamma X$
71.4 ⁺ _{-3.1} ± 2.7	19 ± 3k	⁵ AUBERT	08V BABR	$\Upsilon(3S) \rightarrow \gamma X$

• • • We do not use the following data for averages, fits, limits, etc. • • •

67.1 ± 3.4 ± 2.3	10 ⁺ ₋₄	^{5,6} DOBBS	12	$\Upsilon(2S) \rightarrow \gamma$ hadrons
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- ⁴With floating width. Not independent of the corresponding mass measurement.
- ⁵Assuming $\Gamma_{\eta_b(1S)} = 10$ MeV. Not independent of the corresponding γ energy or mass measurements.
- ⁶Obtained by analyzing CLEO III data but not authored by the CLEO Collaboration.

NODE=M171M2;LINKAGE=MI
 NODE=M171M2;LINKAGE=AU
 NODE=M171M2;LINKAGE=DO



γ ENERGY IN $\Upsilon(3S)$ DECAY

NODE=M171DM
 NODE=M171DM

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
$920.6^{+2.8}_{-3.2}$ OUR AVERAGE				
$918.6 \pm 6.0 \pm 1.9$	$2.3 \pm 0.5k$	⁷ BONVICINI	10 CLEO	$\Upsilon(3S) \rightarrow \gamma X$
$921.2^{+2.1}_{-2.8} \pm 2.4$	$19 \pm 3k$	⁷ AUBERT	08V BABR	$\Upsilon(3S) \rightarrow \gamma X$

⁷Assuming $\Gamma_{\eta_b(1S)} = 10$ MeV. Not independent of the corresponding mass or mass difference measurements.

NODE=M171DM;LINKAGE=BO

γ ENERGY IN $\Upsilon(2S)$ DECAY

NODE=M171U2S
 NODE=M171U2S

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
$609.3^{+4.6}_{-4.5} \pm 1.9$	$13 \pm 5k$	⁸ AUBERT	09AQ BABR	$\Upsilon(2S) \rightarrow \gamma X$

⁸Assuming $\Gamma_{\eta_b(1S)} = 10$ MeV. Not independent of the corresponding mass or mass difference measurements.

NODE=M171U2S;LINKAGE=AU

$\eta_b(1S)$ WIDTH

NODE=M171W
 NODE=M171W

VALUE (MeV)	EVTS	DOCUMENT ID	TECN	COMMENT
$10.8^{+4.0+4.5}_{-3.7-2.0}$	34k	⁹ MIZUK	12 BELL	$e^+e^- \rightarrow \gamma \pi^+ \pi^- +$ hadrons

⁹With floating mass.

NODE=M171W;LINKAGE=MI

$\eta_b(1S)$ DECAY MODES

NODE=M171225;NODE=M171

Mode	Fraction (Γ_i/Γ)	Confidence level
Γ_1 hadrons	seen	
Γ_2 $3h^+3h^-$	not seen	
Γ_3 $2h^+2h^-$	not seen	
Γ_4 $4h^+4h^-$		
Γ_5 $\gamma\gamma$	not seen	
Γ_6 $\mu^+\mu^-$	$< 9 \times 10^{-3}$	90%
Γ_7 $\tau^+\tau^-$	$< 8\%$	90%

DESIG=7
 DESIG=1;OUR EST;→ UNCHECKED ←
 DESIG=2;OUR EST;→ UNCHECKED ←
 DESIG=4
 DESIG=3;OUR EST;→ UNCHECKED ←
 DESIG=5
 DESIG=6

$\eta_b(1S) \Gamma(i)\Gamma(\gamma\gamma)/\Gamma(\text{total})$

NODE=M171230

 $\Gamma(3h^+3h^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_2\Gamma_5/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<470	95	ABDALLAH	06	DLPH	161-209 e^+e^-
<132	95	HEISTER	02D	ALEP	181-209 e^+e^-

NODE=M171G1
NODE=M171G1 $\Gamma(2h^+2h^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_3\Gamma_5/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<190	95	ABDALLAH	06	DLPH	161-209 e^+e^-
<48	95	HEISTER	02D	ALEP	181-209 e^+e^-

NODE=M171G2
NODE=M171G2 $\Gamma(4h^+4h^-) \times \Gamma(\gamma\gamma)/\Gamma_{\text{total}}$ $\Gamma_4\Gamma_5/\Gamma$

VALUE (eV)	CL%	DOCUMENT ID	TECN	COMMENT
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• • • We do not use the following data for averages, fits, limits, etc. • • •

<660	95	ABDALLAH	06	DLPH	161-209 e^+e^-
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NODE=M171G3
NODE=M171G3 $\eta_b(1S)$ BRANCHING RATIOS

NODE=M171235

 $\Gamma(\text{hadrons})/\Gamma_{\text{total}}$ Γ_1/Γ

VALUE	EVTS	DOCUMENT ID	TECN	COMMENT
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seen	34k	MIZUK	12	BELL $e^+e^- \rightarrow \gamma\pi^+\pi^- + \text{hadrons}$
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NODE=M171R03
NODE=M171R03 $\Gamma(\mu^+\mu^-)/\Gamma_{\text{total}}$ Γ_6/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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$<9 \times 10^{-3}$	90	10 AUBERT	09Z	BABR $e^+e^- \rightarrow \Upsilon(2S, 3S) \rightarrow \gamma\eta_b$
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¹⁰ Obtained using $B(\Upsilon(2S) \rightarrow \gamma\eta_b) = (4.2^{+1.1}_{-1.0} \pm 0.9) \times 10^{-4}$ and $B(\Upsilon(3S) \rightarrow \gamma\eta_b) = (4.8 \pm 0.5 \pm 0.6) \times 10^{-4}$. This limit is equivalent to $B(\eta_b \rightarrow \mu^+\mu^-) = (-0.25 \pm 0.51 \pm 0.33)\%$ measurement.

NODE=M171R01
NODE=M171R01

NODE=M171R01;LINKAGE=AU

 $\Gamma(\tau^+\tau^-)/\Gamma_{\text{total}}$ Γ_7/Γ

VALUE	CL%	DOCUMENT ID	TECN	COMMENT
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$<8 \times 10^{-2}$	90	AUBERT	09P	BABR $e^+e^- \rightarrow \gamma\tau^+\tau^-$
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NODE=M171R02
NODE=M171R02 $\eta_b(1S)$ REFERENCES

NODE=M171

DOBBS	12	PRL 109 082001	S. Dobbs <i>et al.</i>	
MIZUK	12	PRL 109 232002	R. Mizuk <i>et al.</i>	(BELLE Collab.)
BONVICINI	10	PR D81 031104	G. Bonvicini <i>et al.</i>	(CLEO Collab.)
AUBERT	09AQ	PRL 103 161801	B. Aubert <i>et al.</i>	(BABAR Collab.)
AUBERT	09P	PRL 103 181801	B. Aubert <i>et al.</i>	(BABAR Collab.)
AUBERT	09Z	PRL 103 081803	B. Aubert <i>et al.</i>	(BABAR Collab.)
AUBERT	08V	PRL 101 071801	B. Aubert <i>et al.</i>	(BABAR Collab.)
ABDALLAH	06	PL B634 340	J.M. Abdallah <i>et al.</i>	(DELPHI Collab.)
HEISTER	02D	PL B530 56	A. Heister <i>et al.</i>	(ALEPH Collab.)

REFID=54288
REFID=54718
REFID=53231
REFID=53106
REFID=53062
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REFID=52262
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